

Addenda

Page 61, Section 2.5.1.1.1: For illustration of the dependence of sensory organisation on motor activity, see Almassy, N., Edelman, G. M., & Sporns, O. (1998). Behavioral constraints in the development of neuronal properties: a cortical model embedded in a real-world device. *Cerebral Cortex*, 8(4), 346-361. This work explicitly analysed the neural consequences of behavioural and environmental interactions. The authors observed that continuous self-generated movement is essential to the development of translation invariance; foveal preference emerges from a bias towards handling objects in the centre of the visual field; and mapping of cortex to classes of input is dynamic and continuous.

Page 70, line 13: The ‘correct’ representation is a necessary step to the solution of the problem, though alas not always sufficient.

Page 72, line 15: The interference patterns are putatively caused by light bending around the bodies of various cells in the retina before reaching the photoreceptors. Lauinger (1996) hypothesised that photoreceptors consequently signal these interference patterns rather than the intensity values of points in the optic array.

Page 77, Figure 3.1: Here axes are not given units because they are intentionally non-specific. They are concerned with *relative* magnitude on *any* scale. Similarly for Figure 3.2. In Figures 4.5 and 4.6 it is again only the relative differences that are important. The absolute values depend on the arbitrary quantising of data carried out by the video hardware. In Figures 5.2 and 5.3 (a) and (b) the units are pixels. This is explained in the captions.

Page 96, lines 9-11: It is suggested that axons converge on similarly signalling neurons. These neurons can only be signalling similarly if they have already been synapsed by other axons rising from a common source, or are in fact the lateral neighbours of the cell in question. It is not suggested that posterior neurons will be signalling similarly by coincidence. In fact, this would be highly deleterious to the algorithm.

Page 127 Section 4.1.11: The JIGSAW algorithm cannot guarantee an ordered geometrical representation of space, since it is wholly dependent on there being order in the data it receives. It may actually undo order if there is overwhelming spurious correspondences between incoming data. However, if correspondence is normal, convergence is only a matter

of time. The condition for termination therefore, is that normal correspondence must be greater than spurious correspondence. The complexity of JIGSAW is $O(n)$, since each pixel is compared to only a fixed number of others, rather than the entire set. The size of the comparison subset may be adjusted arbitrarily.

Page 138, lines 1-6: For local application of nonlinear relaxation and vector median filtering to the estimation of optical flow, see Colombo, C., Del Bimbo, A., & Sandini, S. (1995). Optical flow by nonlinear relaxation. *Pattern Recognition*, 28(7), 977-988. Also very relevant in this context is Lee, D. N. (1976). A theory of visual control of braking based on information about time to collision. *Perception*, 5(4), 437-459.

Page 147, lines 15-19: It has been pointed out, on Page 153, lines 15-20, that periphery-biased attentional control does indeed have a biological counterpart. The superior colliculus, involved in reactive eye movements, is sensitive to *only* the periphery of the retina. So while foveal acuity seems adapted to motion tracking, the superior colliculus seems adapted to reactive motion capture.

Page 148, lines 3-9: Any form of sampling with radial symmetry (e.g., log-polar) will require significantly less efficient transfer of data from a frame grabber, since either individual pixels, or large blocks of data must be transferred. DIEM's advantage, in common with other Cartesian-based systems, is that it requires only discrete lines to be transferred.

Page 163, Section 6.1.5.2: A similar concept, in which only what is not predictable is transmitted through neural layers (in the visual system of the fly), is discussed in Srinivasan, M. V., Laughlin, S. B., & Dubs, A. (1982). Predictive coding: a fresh view of inhibition in the retina. *Proceedings of the Royal Society of London, Series B*, 216, 427-459. This paper also contains interesting research on spatial auto-correlation in natural scenes, very germane to that of Chapter 4, *Organising the Sensorium - JIGSAW*.

Page 177, lines 6-11: The algorithms were run with a variety of environments: indoors (different locations in two different laboratories), outdoors (a car park featuring people, traffic and wind-blown trees), and using television sequences. Though several simple environments were used during testing, no other environment was artificially simplified to make the results clearer or more successful. In fact, JIGSAW benefits from increased complexity, both spatial and temporal, since it depends on *differences* in signals.